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1. In this question, we will give unequal weightage to errors in linear regression setup.

   For i^{th} observation, the error is given by $e_i = (y_i - \hat{y}_i)$, where y_i is the actual value and $\hat{y}_i$ is the predicted value. We weigh the error by r_i. Our objective is to minimize the weighted sum of squared errors, i.e., $\sum_{i=1}^{n} r_i e_i^2$.
   Assuming you can form a vector/matrix from r_i's, write down the objective function in matrix form, and find the optimal θ's.

2. Given a simple model, $\hat{y} = \theta_1 x$, where x is the input and θ_1 is the parameter to be estimated. What is the optimal value of θ_1 in terms of the data?

3. Given a simple model, $\hat{y} = \theta_0$, where x is the input and θ_0 is the parameter to be estimated. What is the optimal value of θ_0 in terms of the data?

4. Suppose I want to put a hard constraint for linear regression that all the coefficients should be positive. How can I do that?

5. Prove that stochastic gradient is an unbiased estimator of the true gradient.

6. Prove that the expected size of bootstrapped sample 0.632 times the original sample size.